In this thesis we have studied semi-Markov decision processes with partial observations on the infinite planning horizon. In chapter 2, we have studied an optimal control problem of partially observable semi-Markov, decision processes with discounted cost criterion. On the infinite planning horizon, there are two standard cost criteria namely; discounted cost and the limiting time average cost. In the optimal control problem, the objective of the limiting time average cost is to minimize.

$$\limsup_{T\to\infty} \frac{1}{T} E_{\psi}^{\pi}[\int_0^T c(X_t, A_t)\, dt], \qquad (4\ 0\ 1)$$

over all admissible policies. To study this cost criterion, one has to first investigate the stability property of semi-Markov decision process with partial observation. This problem is currently under observation. In Chapter 3, we have studied a zero sum stochastic game with discounted payoff. We plan to investigate the average cost criterion. Again in Chapter 3, we have assumed that both the players have identical observations. In case, where different players have different observations, the problem becomes quite involved. We plan to address this problem in future.